[*From the Proceedings of the Physiological Society*, July 3, 1915.]
*Journal Physiology, Vol. XLIX.*

**Polarisable as against non-polarisable electrodes.** By

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That non-polarisable as opposed to polarisable electrodes must be employed in accurate electrocardiographic work is re-iterated by the present communication. A. If an E.M.F. of 1 millivolt is introduced (Fig. 1 *in*) into the simple closed circuit of a properly tuned string galvanometric recorder, and is cut out later (Fig. 1 *out*), the record

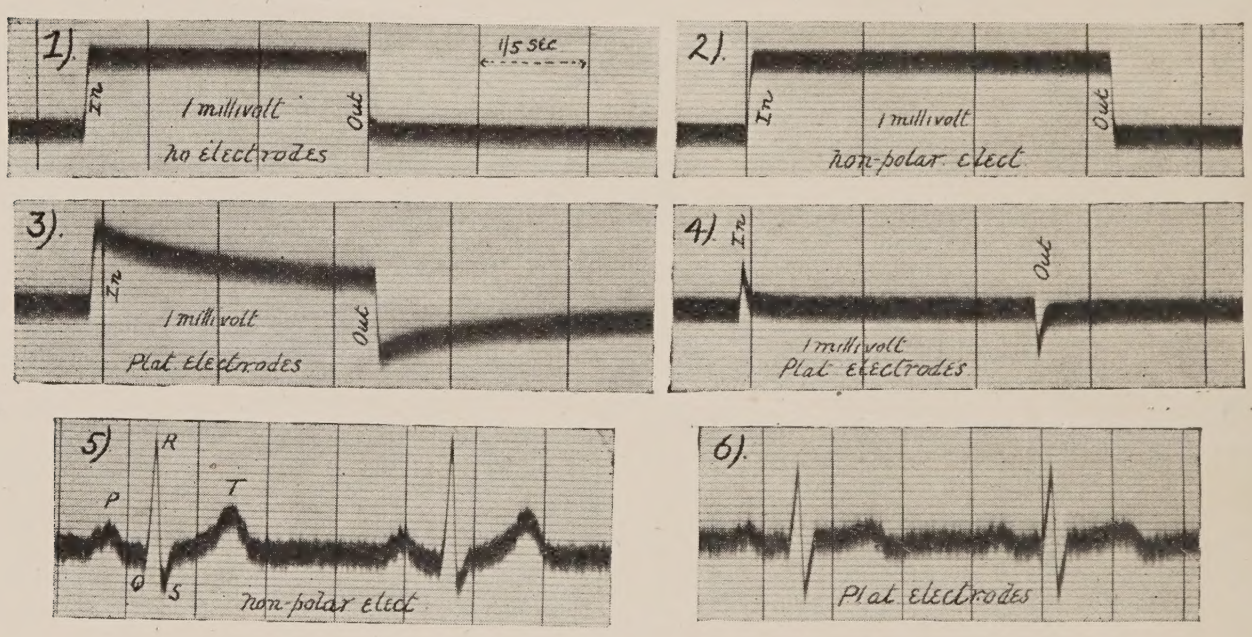


Fig. 1. 1 millivolt was introduced into, and cut out of, a simple closed circuit. Circuit resistance = 4800 ohms (string 2800 ohms; added resistance 2000 ohms). The excursion of the fibre is "dead beat" as it should be, and 10 scale divisions in amplitude. Fig. 2. 1 millivolt similarly introduced into, and cut out of, the same circuit containing non-polarising electrodes. Total circuit resistance 4800 ohms (string resistance 2800 ohms; electrodes and salt solution 1850 ohms; added resistance 150 ohms). Figs. 3 and 4. 1 millivolt introduced into, and cut out of, the same circuit containing polarising platinum electrodes; total circuit resistance 4800 ohms (string 2800 ohms; electrodes and salt solution 250 ohms; added resistance 1750 ohms). The sensitivity of the string was constant throughout the series. Fig. 5. Human electrocardiogram taken by means of the non-polarisable electrodes (of Fig. 2); standardised so that 10 scale divisions = 1 millivolt. Fig. 6. Curves from the same heart and lead, taken with polarising platinum electrodes (of Fig. 4). The total circuit resistance and string sensitivity were identical in the case of the two electrocardiograms.

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is as here depicted. It represents, as accurately as modern instruments will permit, the flow of current through the fibre. B. If the millivolt is introduced into the same circuit, in which is interposed a pair of non-polarising electrodes, separated by a fixed interval of normal saline, then, providing string tension and total circuit resistance remain unaltered, *an identical record is obtained* (Fig. 2). C. But if, in similar circumstances, *polarisable* electrodes (of platinum) are utilised, *the record suffers distortion.* If the electrodes polarise slowly, distortion is present (Fig. 3); if they polarise rapidly, distortion is the greater (Fig. 4). Distortion is due to the rapid development and maintenance of a charge on the surface of the electrodes, while current is flowing through them. In the second figured instance of polarisation (Fig. 4), (*a*) the amplitude of the initial deflection, produced by the E.M.F. introduced, is materially reduced, owing to the rapidity with which polarity develops; (*b*) although the E.M.F. is maintained, the string returns to zero, and (*c*) on cutting out the E.M.F., the string is deflected across the zero line, by the now unbalanced charge on the electrodes. All these effects are clearly *defects* in the record.

If with readily polarisable electrodes a true record of a simple current change is unobtainable, it is unreasonable to believe that complex currents developed by the heart beat will be accurately recorded. In point of fact, the resultant distortions can be predicted. The upstroke of an initial deflection *R* will be reduced in amplitude because it will be neutralised by the developing polarity. As *R* subsides, the string will deflect across the zero line and will produce an artefact resembling *S* (if *S* is not present) or exaggerate *S* (if *S* is present); the final summit *T* will be similarly reduced in magnitude by neutralisation, and will be followed by an artificial depression as *T* subsides. That such distortion actually results is clearly shown by Figs. 5 and 6 in which each of these changes is to be observed.

In electrocardiography the use of electrodes which polarise appreciably is indefensible, because (1) it is impossible to accept the standardisation of the corresponding curves against a known E.M.F. and (2) because the curves themselves suffer material distortion.